Dung Beetles on the Move

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Since 1967 the CSIRO Division of Entomology has been releasing dung beetles in Northern Australia, and several species have become well established. One, *Onthophagus gazella*, has spread spectacularly, and already it has apparently begun to control that menace to cattlemen in the north — the buffalo fly. The beetles should improve soil fertility too. The Division has now begun liberating new species in the southern half of the continent that should help to reduce the bushfly nuisance.

Dr. G. F. Bornemissza of the CSIRO Division of Entomology first put forward the idea of introducing dung beetles into Australia in a scientific paper published in 1960 (see *Rural Research* 34), and in 1963 the present programme began under his leadership. He pointed out that in most of the warmer countries of the world dung beetles carry out the very important task of clearing away the droppings of native animals. They achieve this by burying them in the ground while still fresh for use as food for themselves and their offspring. Here in Australia indigenous beetles do the same with the pellet-like droppings of the native marsupials, but they cannot cope with the large wet dung pats of domestic stock introduced by European Man.

Cattle and their close relatives evolved in Asia and Africa, and with them evolved beetles that can use their dung. The CSIRO programme involves introducing the best of these into Australia, and the Organization believes that they will have three beneficial effects. At least during the warmer months, they will:

free pastures from dung accumulation,
fertilize the soil,
control pests.

Cow pats often last for months or even years in Australia, so they cover considerable areas of ground and prevent pasture growth. Termites have a major effect in removing dung, but they take months to do so. Australia's 20 million-odd cattle each produce about 10 pats a day, so many hundreds of thousands of acres of pasture must be lost annually for this reason. Dung beetles could prevent this loss.

As everyone knows, most Australian soils lack fertility. Fresh dung contains nitrogen, which is lost into the atmosphere when the dung lies on the surface of the ground. In one experiment, Dr. Bornemissza, with Dr. C. H. Williams of the CSIRO Division of Plant Industry, showed that — by burying the droppings of stock—dung beetles could considerably increase soil fertility.

Two major Australian pests breed in cattle dung — the bushfly and the buffalo fly (see *Rural Research* 65). Dung beetles cannot always prevent these insects from laying eggs in the fresh droppings, but if they bury these droppings before the flies have completed their development then they will effect control.

Dung also contains eggs of parasitic worms, and rapid burial of pats would reduce the number of infective larvae reaching grass blades and hence the gut of stock.

Such are the expected results of the dung beetle introduction programme. It has already achieved some progress towards these goals.

Releases in the tropics

In April 1967, Dr. Bornemissza and his group began releasing four species of dung beetles at selected sites, mainly in tropical Australia. They had selected the species from African and Asian beetles previously introduced into Hawaii to control horn fly (a close relative of the buffalo fly). In the three ensuing summers they liberated about 275,000 beetles, and one species, *Onthophagus gazella*, has made spectacular progress. Within two years it had colonized 400 kilometres of the northern Queensland coast around Townsville and penetrated 80 km inland — closing the 80-km gaps between release sites in the process. During the first year it proved its ability to make long-distance flights by crossing 7 km of water to colonize Magnetic Island, near Townsville (see *Rural Research* 70). A year later it reached Palm Island — a distance of 30 km across the sea.

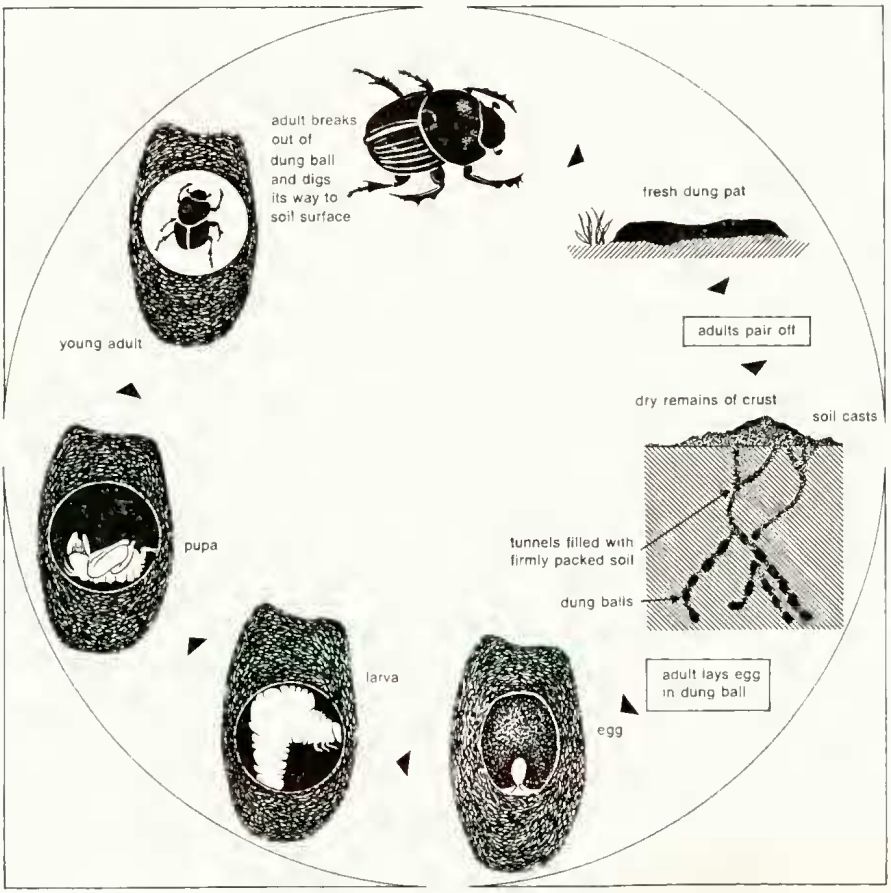

Figure 1. The dung-burying process — why the beetles do it.

Other species have not done so well, but fewer beetles were released and they do not reproduce as fast as *O. gazella*. They certainly have not yet failed.

As a back-up measure, the entomologists also introduced three dung-inhabiting histerid beetles from Hawaii and Fiji, and these again had African or Asian origins. Two have become established. Instead of burying the dung, these histerids attack the developing larvae of flies within it. Thus they should reduce fly populations where the dung beetles do not bury the dung fast enough.

Since their release in 1967, the introduced beetles have survived and flourished during periods of both exceptionally heavy rain and severe drought. Obviously therefore they can adapt most effectively to the climate of northern Australia.

Less buffalo fly

Already the Division of Entomology considers that at least some of the objects of the programme have been achieved in the colonized area surrounding Townsville. Dung disposal has proved much more rapid during the wet summer period, and between December and March the buffalo fly nuisance does appear to have abated. The numbers of other dung-breeding flies also appear much reduced. Beetle activity slows down markedly in the dry, cool season between April and October, and so there still remains a dung disposal problem at this time. Mercifully, buffalo fly numbers too are much reduced just then.

Observations over several seasons show that, with the present beetles, buffalo fly numbers may reach troublesome levels at two periods:

in spring, when temperature and rainfall conditions have become suitable for fly reproduction, but the beetles have not yet become active enough to dispose of all dung,

in autumn, when temperatures have fallen low enough to inhibit beetle activity more than buffalo fly reproduction.

It is hoped that it will be possible to find species to fill these gaps and Dr Bornemissza is now in Africa searching for them.

In the meantime the Division of Entomology would encourage any efforts by interested people to help spread the beetles. They can be easily trapped — using a bucketful of sand with a cowpat on top, which is sunk so that the top of the bucket is flush with the soil surface — and transferred from one property to another. Any farmer knowing another on whose property beetles have already become established, and who wishes to introduce them on to his own, can obtain further information from the Division of Entomology, CSIRO, P.O. Box 109, Canberra City, A.C.T., 2601.

Beetles for southern Australia

Phase one of the programme — introducing the first dung beetles into tropical Australia — has been completed. Phase two — introducing them into the southern half — began early this summer. At Pretoria in South Africa Dr. Bornemissza has set up a laboratory, which he is using as a base to search for suitable beetles. Australia needs species for all its cattle-raising areas, and these cover such a wide range of climates, soils, and pasture types that a hundred or more different beetles may be required. Fortunately, there are some 1,800 known species south of the Sahara to choose from.

After one season's investigation Dr. Bornemissza had already sent back eight dung beetles and two histerids (predatory on fly larvae) — now being bred up in large numbers in Canberra — and some were released earlier this summer. These should prove suitable

for a variety of climates, with annual rainfalls varying between 10 and 40 in. in temperate areas and 15 and 35 in. in the tropics. One species of histerid suitable for the very wet tropical areas was released around Daintree and Tully in 1968, but this has not thrived and possibly a more suitable species for this area will crop up later.

Any introduction programme of this type will raise fears about introducing diseases and about the effects of beetles on other endemic fauna. They must, of course, breed rapidly and respond well to handling, but they must also breed only in dung. The beetles go through a rigorous quarantine procedure so that they cannot carry any disease in with them, and this procedure is described in some detail here since it illustrates well the complicated precautions that must be taken before insects can be released in Australia.

Beetles of the selected species having been paired, the resulting eggs are extracted from the brood balls and surface-sterilized in 3% formaldehyde solution. They are then packed in specially designed containers (sent from Australia) and air-freighted to Canberra, where Mr. P. Ferrar and his helpers wash them and place them in hand-made dung balls of "clean" Australian dung — a lengthy procedure since up to 1,500 eggs may arrive in a single batch. The team rear the eggs through to adults that never leave quarantine. They then collect the eggs of this generation, cleanse and surface-sterilize them, and place them in turn in "clean", hand-made dung balls. The adults that emerge from these eggs are then used for mass breeding for field release. Thus the beetles must pass through one complete generation in quarantine before release for mass breeding.

Slow starters

A word of warning — once released in the field the beetles appear to be slow starters. During the first year or so, even when they are breeding well, little sign of the beetles may be visible at the release sites. After a year or two, however, destruction of dung pats gradually becomes apparent, and so lack of any sign of the beetles does not mean that they have failed to become established. Almost inevitably those released in the south will take longer to produce results than the very successful *O. gazella*, since temperate species breed more slowly.

No risk

What risk is there that the beetles themselves may become pests? Dr. Bornemissza and his colleagues are confident that this cannot happen. The adults feed exclusively by sucking fluids from fresh dung — they cannot chew anything. They will not reduce reseeding within the pastures by burying the seeds, since they remove all irregularities from the dung and leave them on the surface. While burying the dung the beetles should in fact help reseeding by creating loose, well-fertilized seed-beds. The larvae do have chewing jaws for feeding on the fibrous dung balls, but they die very quickly if these balls are opened and so they cannot break out and feed on other materials.

Further reading

Could dung-eating insects improve our pastures? G. F. Bornemissza. *Journal of the Australian Institute of Agricultural Science*, 1960, **26**, 54-6.

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